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Research Article

The Trichoptera of Panama XXVIII. Nine new species of microcaddisflies (Trichoptera, Hydroptilidae)

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Abstract

In this study, we describe and illustrate nine new species of microcaddisflies: *Oxyethira jaramillo* **sp. nov.**, *Neotrichia afuera* **sp. nov.**, *Neotrichia aguirrei* **sp. nov.**, *Neotrichia betegui* **sp. nov.**, *Neotrichia rancheria* **sp. nov.**, *Neotrichia sona* **sp. nov.**, *Metrichia riosi* **sp. nov.**, *Ochrotrichia mariettae* **sp. nov.** and *Ochrotrichia martinez* **sp. nov.** The majority of these new species were collected on the Soná Peninsula or offshore on the Coiba National Park islands. With these additions, there are now 544 species of caddisflies known from Panama, distributed amongst 15 families and 56 genera.

Key words: Neotropics, Isla Canales de Afuera, Isla Rancheria, Coiba National Park

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Introduction

During the last nine years, a concentrated investigative effort has more than doubled the number of known caddisfly species for Panama from 257 in 2015 to 535 in 2024, distributed amongst 15 families and 56 genera (Armitage et al. 2024). Concomitant with this increase in species was the additional gain of two families and 11 genera. These increases were made possible by adoption of an integrated sampling scheme involving multiple methods (primarily light traps and Malaise traps in combination) employed monthly for extended periods (usually January through June) at each collection site. Our knowledge of the family Hydroptilidae has been a particular beneficiary of this approach, generating more new species to science and new country records than for all other caddisfly families combined (Armitage et al. 2024).

The Aquatic Invertebrate Research Group (AIRG) at the Universidad Autónoma de Chiriquí (UNACHI) and its Museo de Peces de Agua Dulce e Invertebrados (MUPADI) is currently focused on increasing our knowledge of Trichoptera (caddisflies), Plecoptera (stoneflies), chironomids (mime midges) and dryopoid beetles in Panama. Towards that goal, it has secured registered projects for these four orders of aquatic insects. The new taxonomic information presented in this paper is a direct result of executing these projects.

A comprehensive summary of the results of AIRG research (2015 through 2024) into the Trichoptera of Panama can be found in Armitage et al. (2024). Based on more recent work, we herein describe and illustrate nine new species for addition to Panama's caddisfly fauna, primarily from the Soná Peninsula and Coiba National Park areas of southern Panama.

Materials and methods

The Panamanian Environment

The flora and fauna of Panama is species-rich due to its tropical location and topography and the resulting diversity of microclimates and habitats. In terms of aquatic habitats, Panama contains over 500 rivers, countless creeks and other types of lotic and lentic waterbodies. A more thorough description of its geology, topography, climate and habitats can be found in Armitage et al. (2024). For members of the family Hydroptilidae, an overabundance of habitats and resources exists to override any thoughts of species diversity being limited by competition.

Primary study areas (Fig. 1)

Jarmillo Corregimiento

The Jaramillo Corregimiento is a political subdivision (77.5 km^2) of Boquete District in Chiriqui Province, Panama. Located west of Boquete, it is the first range east of Volcan Baru which anchors the western end of the Central Cordillera of Panama. Primarily forested and mountainous, the hydrography on its south-western face includes Quebrada Jaramillo and its tributaries.

Landis Reserve

Landis Reserve is a private landholding in Chiriquí Province located north of Paso Canoas, which produces plants that are used in soil stabilisation efforts. The stream sampled in this study is unnamed and of first-order, located near the Costa Rican border. Ultimately, it flows into the Río Chiriquí Viejo and from there into the Pacific Ocean. The riparian corridor is primarily forested with some open areas.

Coiba National Park

Coiba National Park is located in the Gulf of Chiriqui off Panama's Pacific coast, south of the Soná Peninsula and west of the Azuero Peninsula, the latter defining the eastern limit of the Gulf. The Park is a marine reserve that incorporates or includes 38 islands and the waters surrounding them (in total, almost ~ 70,585 acres). In 2005, the Park was recognised as a World Heritage Site by UNESCO.

Soná Peninsula

Soná Peninsula is an unofficial name for a portion of Panama's southern coast that juts out into the Gulf of Chiriqui (Pacific Ocean). It is comprised of the Soná District and Soná Corregimiento of Veraguas Province. It is immediately west of the much

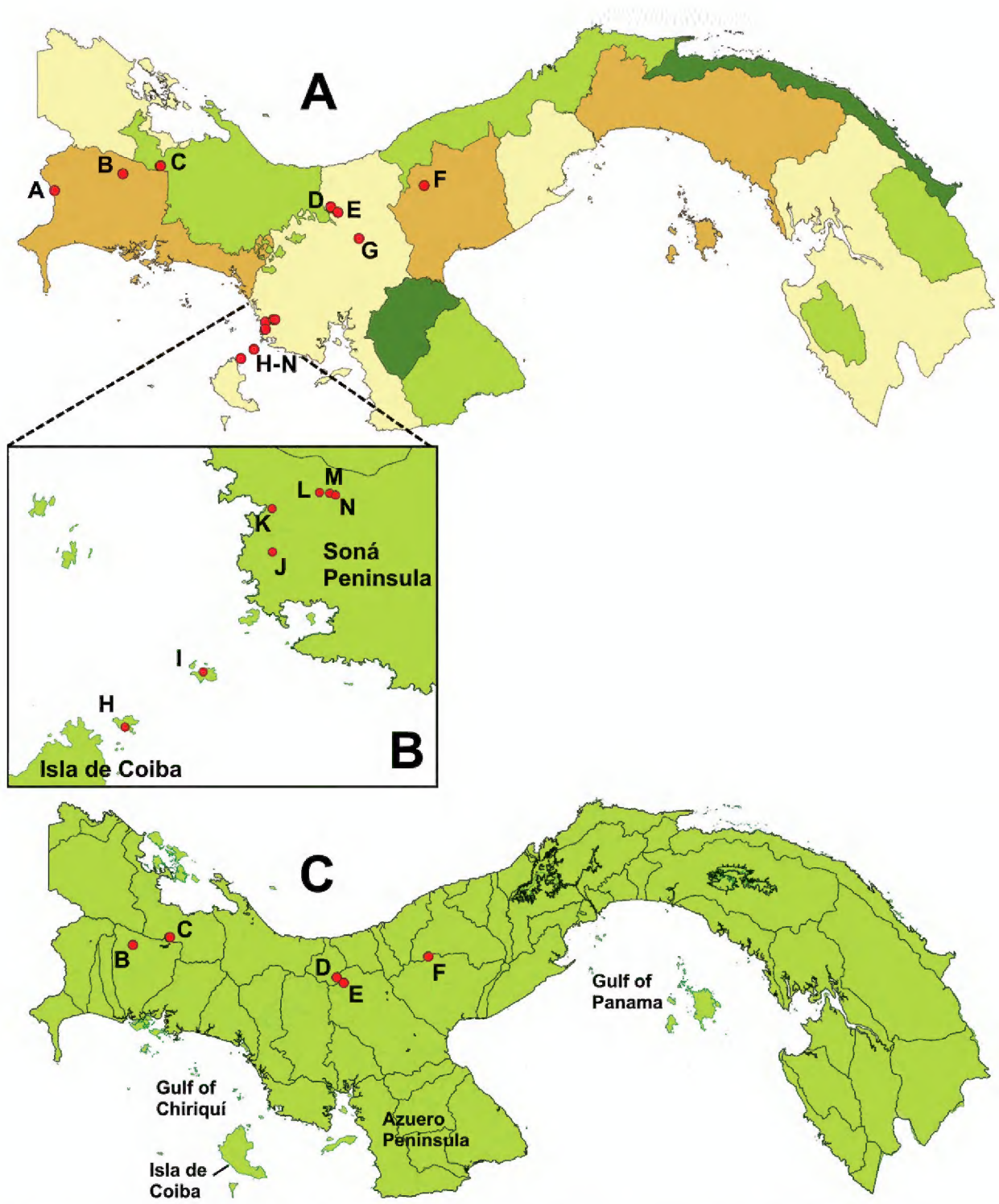

Figure 1. Maps of collection sites **A** Panama map with administrative unit (provinces and indigenous areas) overlay showing the relative positions of all sampling locations pertinent to this publication **B** expanded view of the western Soná Peninsula and northern portion of Coiba National Park **C** Panama map with a major cuenca (watershed) overlay showing the location of collection sites for *Ochrotrichia martinez* sp.nov., the most widely distributed species within Panama of the nine species described herein [**A**–Landis Reserve; **B**–Quebrada Jaramillo Abajo; **C**–Quebrada Martínez; **D**–Río Calovebora; **E**– Quebrada Primo Brazo Mulabá; **F**–Quebrada Corazones; **G**–Río Beteguí; **H**–Isla Rancheria; **I**–Isla Canales de Afuera; **J**–Quebrada Monita; **K**–Quebrada del Rosario; **L**–Quebrada la Mina; **M**–Río Indio; **N**–Río Limón].

larger Azuero Peninsula. These two peninsulas and the nearby Coiba Island include accreted terrains transported in the past by the Pacific plate as it underwent subduction under the Caribbean plate and incorporated into Panama's landmass.

Bosque Protector Palo Seco

The Bosque Protector Palo Seco protected area in western Panama occupies a portion of the Talamanca Cordillera, Central Cordillera and Caribbean slope lowlands and is part of both the Ngäbe-Buglé Comarca and Bocas del Toro Province. It connects the eastern part of La Amistad International Park with the Fortuna Forest Reserve. The Río Guabo watershed is a dendritic, Caribbean watershed, with a first-order creek, Quebrada Martınéz. The Río Guabo empties into the Laguna de Chiriquí, part of the Caribbean Sea, immediately west of the port of Chiriquí Grande. The landscape through which it flows is primarily forested with some agriculture and with a forested riparian corridor for at least some of its length.

National parks and forest reserves indicated above are under the stewardship of the Ministerio de Ambiente (MiAmbiente) and are protected from logging and agriculture. The streams sampled under this project are 1st to 3rd order in size, are of good water quality and are bordered by forested riparian corridors.

Methods

The majority of the collections made in alcohol by AIRG employed light traps (UV fluorescent tubes or an UV LED strips). Whenever possible, Malaise traps were also set up in the same locations, because the combination of UV light traps and Malaise traps has consistently produced the best results in terms of species diversity. Sampling monthly from December to June has produced very good results, equivalent to whole-year sampling. Collecting just once at a given location produces insufficient information about the species assemblage present. Once again, optimum results are achieved with multiple-month collections at the same site and with the two collection methods stated above. Specimens were prepared and examined following standard methods outlined in Blahnik and Holzenthal (2004). Male genitalia were soaked in 5% potassium hydroxide (KOH) overnight and washed in weakly acidified alcohol prior to examination under a dissecting scope.

Morphological terminology used for male genitalia generally follows that of Marshall (1979). Classification and species order below, within the family Hydroptilidae, follow Thomson (2023). Paired structures are described in the singular for simplicity. Although technically, segments VII through X are not part of the genitalia, traditionally, descriptions of these segments have been included under the genitalia heading. We follow that practice here. If segments V and VI have distinct features, they are discussed under the male description. The total length of specimens provided in descriptions represents the length from the tip of the head to the tip of the forewing. Altitude values are given in metres above sea level (m a.s.l.). Maps were created in QGIS software, version 3.28.5-Firenze.

Holotypes listed in this publication are deposited in Museo de Peces de Agua Dulce e Invertebrados (MUPADI) at the Universidad Autónoma de Chiriquí. Paratypes and other specimens are deposited in MUPADI, the University of Minnesota's Neotropical Insect Collection (UMSP) in St. Paul, Minnesota USA or the Carnegie Museum of Natural History (CMNH) in Pittsburgh, Pennsylvania USA.

Results

Taxonomy

Order Trichoptera Kirby, 1813
Suborder Integripalpia Martynov, 1924
Superfamily Hydroptiloidea Stephens, 1836
Family Hydroptilidae Stephens, 1836
Subfamily Hydroptilinae Stephens, 1836

Genus *Oxyethira* Eaton, 1873

Note. The genus *Oxyethira* includes over 253 species of caddisflies (Thomson 2023) distributed around the world. Currently, there are 17 species known from Panama (Armitage et al. 2024). Herein, we describe and illustrate one additional species for the country.

Oxyethira jaramillo sp. nov.

https://zoobank.org/1D9DC88C-B005-42F6-B4E6-B7833B2F1C92
Fig. 2

Type locality. Panama: Chiriqui Province, Cuenca 108, Boquete District, Quebrada Jaramillo Abajo; 8.745827°N, 82.418083°W, 1059 m a.s.l.

Type specimen. Holotype • ♂, in alcohol. Original label: “Panama: Chiriqui Province, Cuenca 108, Boquete District, Quebrada Jaramillo Abajo; 8.745827°N, 82.418083°W, 1059 m a.s.l.; 9 Mar 2019; leg K. Castillo; UV light trap"; MUPADI.

Diagnosis. *Oxyethira jaramillo* sp. nov. is related to a number of species which have elongate dorsal processes from segment IX, such as *O. bidentata* (Mosely), *O. culebra* Holzenthal & Harris and other members of the *O. aeola* group (Kelley 1984). The new species differs in the uneven nature of the dorsal processes from IX with a knobbed apex, which, in the related species, are of equal length and acute apically and in the divided inferior appendage, which is entire in the similar species.

Description. Male. Total length 2.8 mm (n = 1), 29 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 2). Abdominal segment VII annular, with pointed ventromesal process. Segment VIII in lateral view elongate, tapering posteroventrally; in dorsal view, annular; in ventral view, deep V-shaped mesal incision. Segment IX retracted into segments VI, VII and VIII, in lateral view thin, dorsal processes narrowing posteriorly; in dorsal and ventral views, rounded anteriorly, posteriorly reduced to a pair of thin asymmetrical processes, the left side much longer than the right and knobbed apically. Segment X in lateral view truncate; in dorsal view, rounded distally and membranous. Subgenital plate in lateral view divided posteriorly, lower portion shelf-like, upper portion curving downwards; in dorsal and ventral view, with broad mesal incision, pair of thin, setal-bearing arms posteriorly. Inferior appendage in lateral view divided into three rectangular processes, dorsal-most process elongate; in ventral view, pair of lateral processes of uneven length and shape, inner process triangular and short. Phallus in dorsal view thin and sinuate, small rounded knob at apex.

Female and immature stages. Unknown.

Etymology. Named after both the type waterbody, Quebrada Jaramillo, in the western Panamanian highlands and the reversal of the earth’s polarity ~ 900,000 years ago, referred to as the Jaramillo Event (Cox et al. 1963). This latter event was named after Jaramillo Creek in the Jemez Mountains in New Mexico, USA. The word “Jaramillo” is derived from the Spanish word “jaral”, meaning rockrose shrub, with the suffix “illo” forming a diminutive; thus “little rockrose shrub”. The name is a noun in the genitive case.

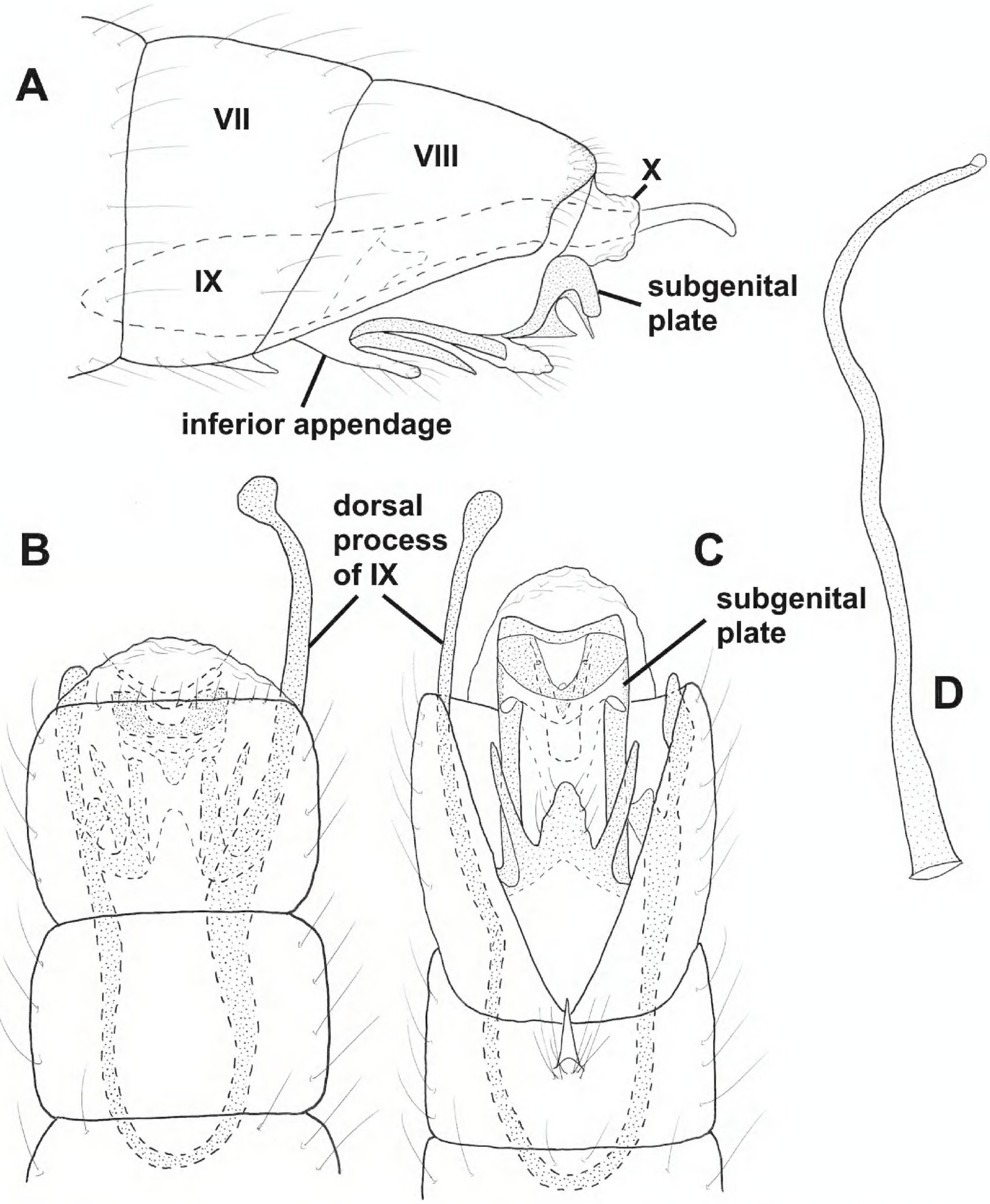

Figure 2. *Oxyethira jaramillo* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal.

Family Hydroptilidae Stephens, 1836
Subfamily Neotrichiinae Ross, 1956

Genus *Neotrichia* Morton, 1905

Note. The genus *Neotrichia*, found in North, Central and South America and the West Indies, contains over 228 species (Thomson 2023; Harris et al. 2024). Currently, there are 45 species known from Panama (Armitage et al. 2024). Herein, we describe and illustrate five additional species for the country.

***Neotrichia afuera* sp. nov.**

https://zoobank.org/0AA20E05-951F-4F7D-B302-F8651FED1C79

Fig. 3

Type locality. Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.

Type specimen. ***Holotype*** • ♂, in alcohol. Original label: "Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.; 6–22 Mar 2023; leg V. Rodriguez; Malaise trap"; MUPADI.

Diagnosis. *Neotrichia afuera* sp. nov. does not fit well within the species groups established by Keth et al. (2015). The apicolateral process of segment IX and the tubular phallus without sclerotised projections would place the new species in the *N. okopa* group, but the short inferior appendages with dorsal process is more similar to species in the *N. caxima* group, which typically have sclerotised hooks on the phallus. The new species is easily recognised by the structure of the sclerotised inferior appendages as seen in ventral view.

Description. Male. Total length 1.4 mm (n = 1), 18 antennal segments, wings and body brown in alcohol. **G*enitalia*** (Fig. 3). Abdominal segment VIII annular. Segment IX tapering anteriorly, posteriorly rounded, sclerotised on margin, giving rise to short sclerotised rod which projects ventrad and widens distally; in ventral view, incised anteriorly and posteriorly; in dorsal view, incised anteriorly, posteriorly fused with segment X, dense setation mesally. Segment X in lateral view elongate and shelf-like, rounded apically; in dorsal view rectangular, fused with segment IX anteriorly and sclerotised on lateral margins. Subgenital plate in lateral view wide basally, tapering distally to acute, downturned apex with stout seta; in ventral view, rectangular, tapering apically into downturned tip, pair of stout setae apicolaterally, and sclerotised on lateral margins. Bracteole in lateral view narrow basally, widening distally; in dorsal and ventral views, narrow basally, widening distally to rounded apex. Inferior appendage in lateral view rectangular, tapering distally to downturned apex, sclerotised on ventral margin, basally with narrow, divided sclerotised process, wider dorsally than ventrally; in ventral view, divided into several processes, anterior processes with mesal and lateral lobes, rounded sclerotised knobs apically, posteriorly with several thin processes, posterior processes narrow, projecting mesally with sclerotised knob apically bearing stout seta. Phallus in dorsal view tubular, constricted at mid-length and bearing thin paramere encircling ejaculatory duct sclerotised, basal portion widening, apical portion parallel-sided, lateral margins slightly sclerotised.

Female and immature stages. Unknown.

Etymology. Named for the isle in Panama where the species was collected.

***Neotrichia aguirrei* sp. nov.**

https://zoobank.org/92688E4D-1682-4CED-87A3-CF57B7E98C9B

Fig. 4

Type locality. Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.

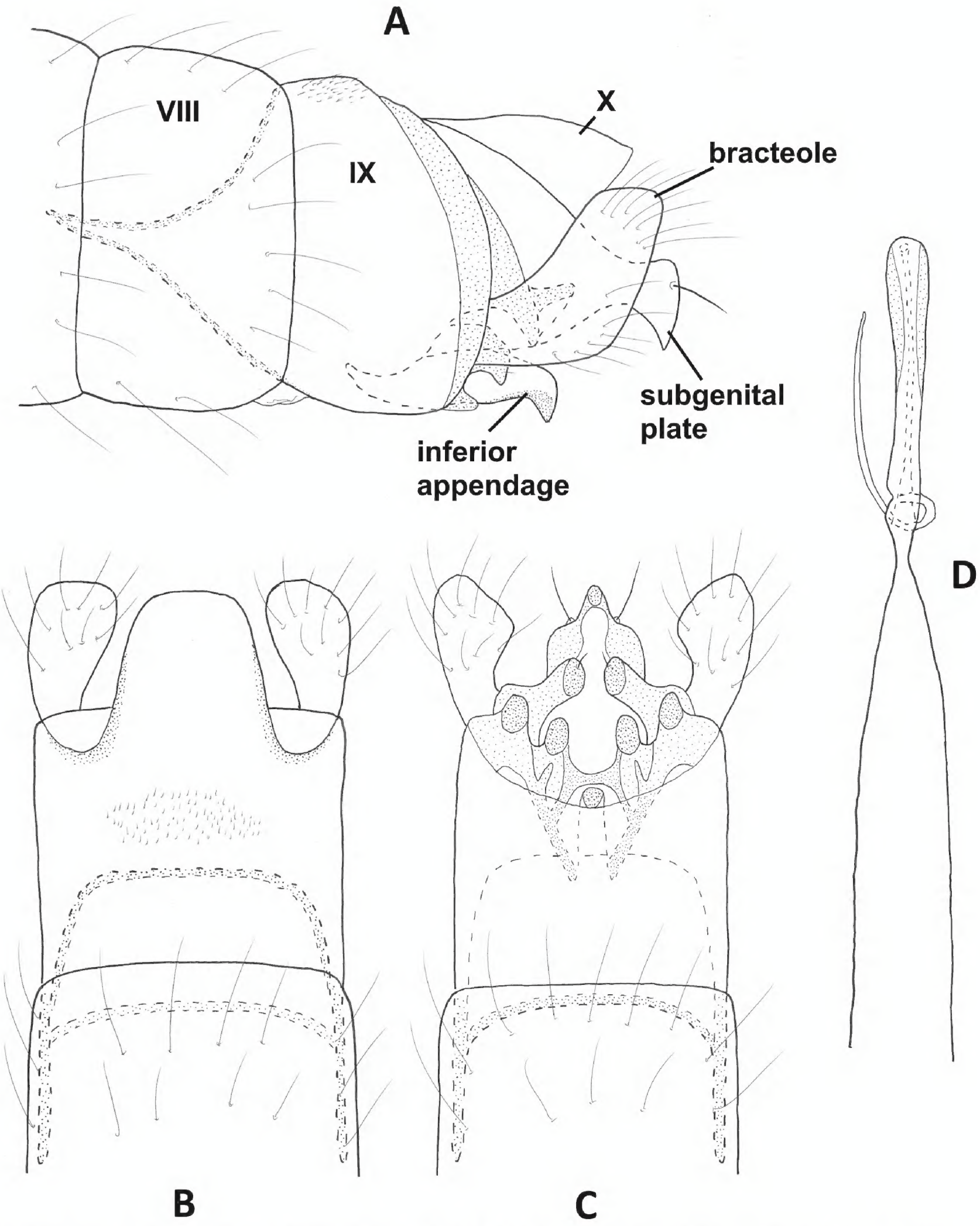

Figure 3. *Neotrichia afuera* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal.

Type specimen. ***Holotype*** • ♂, in alcohol. Original label: "Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.; 6–22 Mar 2023; leg V. Rodriguez; Malaise trap"; MUPADI. ***Paratype*** • ♂, in alcohol; same as holotype.

Other material examined. ♂, in alcohol; Panama, Veraguas Province, Cuenca 116, Soná District, Río Limon; 7.87182°N, 81.49397°W; 67 m a.s.l.; 18 Apr 2023; leg V. Rodriguez; UV light trap; MUPADI.

Diagnosis. *Neotrichia aguirrei* sp. nov. is a member of the *N. canixa* group of Keth et al. (2015), based on the sclerotised apical horns of tergum X and the bifid bracteoles with similarity to *N. palitla* Harris & Flint, which also has

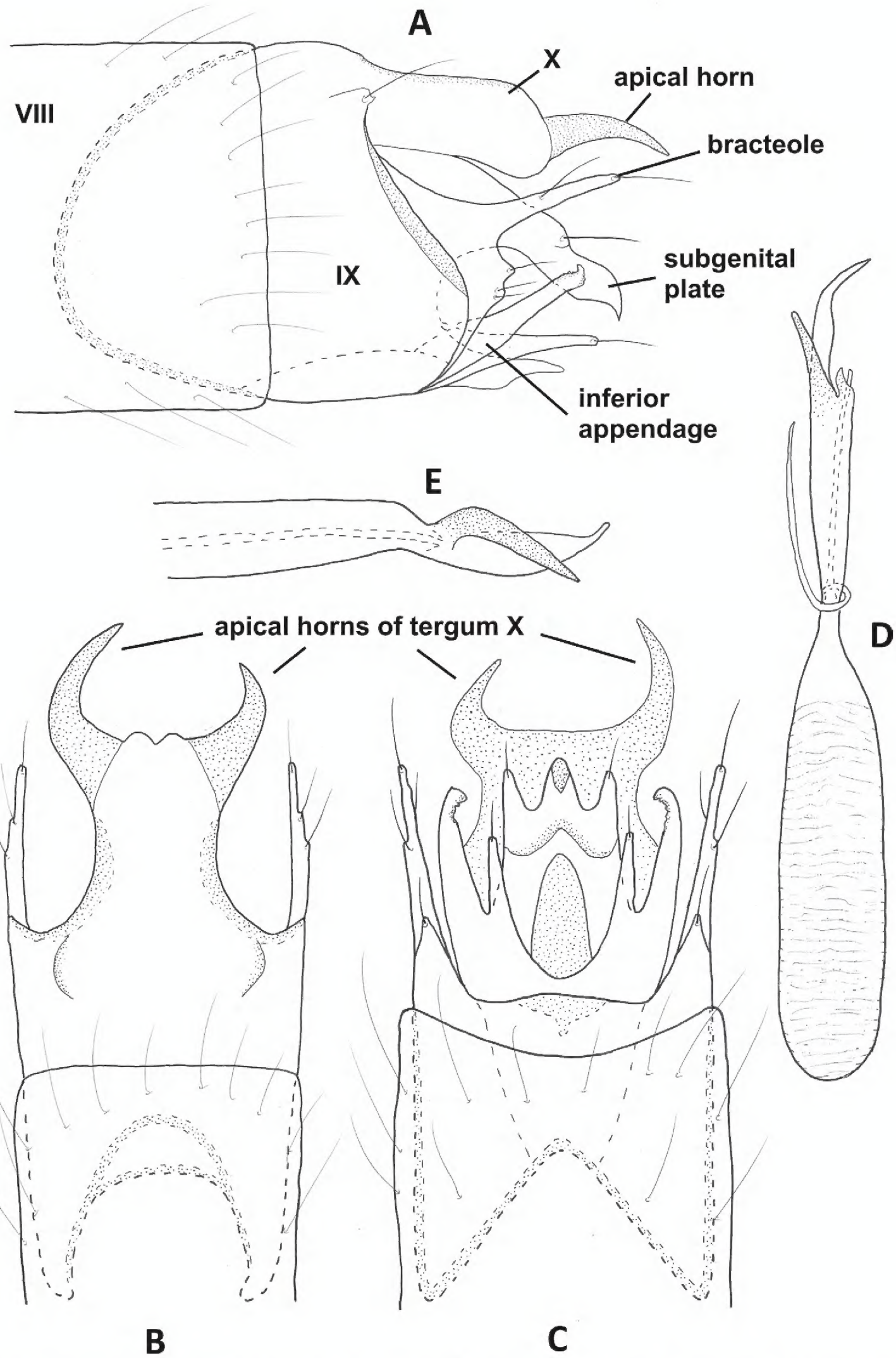

Figure 4. *Neotrichia aguirrei* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal **E** phallus apex, lateral.

the dorsal horns asymmetrical in shape. The new species is separated by the ventral portion of the bracteole being greatly reduced and the subgenital plate being trifid in ventral view, rather than acute as in *N. palitla*.

Description. Male. Total length 1.8 mm (n = 3), 18 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 4). Abdominal segment VIII annular. Segment IX wide ventrally and rounded, narrowing dorsally, anteriorly rounded; ventrally broadly incised, rounded posteriorly, deeply incised anteriorly; dorsally

square. Segment X broad and shelf-like, rounded distally with apical horn narrowing; in dorsal view, rectangular basally, apically with pair of sclerotised horns which are asymmetrical in shape, left horn longer than right, lateral margin incised basally. Subgenital plate in lateral view wide basally, tapering distally to acute apex, thin seta sub-basally; in ventral view rectangular, apically trifid, lateral lobes each bearing a thin seta, inner lobe with sclerotised point apically. Bracteole in lateral view bifid, dorsal process elongate, narrowing distally, ventral process vestigial; in dorsal and ventral views, upper process elongate, tapering distally, lower process short. Inferior appendage in lateral view short, tapering distally, elongate, thin setal-bearing process dorsally; in ventral view, wide basally, tapering distally, rounded apically and rugose on inner margin, inner process thin and elongate bearing seta apically. Phallus in dorsal view tubular, constricted at mid-length and bearing thin paramere encircling shaft, apex divided into pair of processes, one elongate and tapering to acute apex, which is bent, other process short and tapering apically, sclerotised, phallus base serrated in appearance.

Female and immature stages. Unknown.

Etymology. Named for Yusseff P. Aguirre Espinoza, Panamanian biologist at the Museo de Peces de Agua Dulce e Invertebrados of the Universidad Autónoma de Chiriquí in recognition of his intensive and extensive involvement with our studies of aquatic insects in Panama. The name is a noun in the genitive case.

***Neotrichia betegui* sp. nov.**

https://zoobank.org/E2CDA03B-83B8-44DD-A9F1-745CC98D239C

Fig. 5

Type locality. Panama: Veraguas Province, Cuenca 132, San Francisco District, nr. La Perdiz, N of San Francisco, Río Beteguí; 8.36047°N, 80.99481°W, 144 m a.s.l.

Type specimen. Holotype • ♂, in alcohol. Original label: "Panama: Veraguas Province, Cuenca 132, San Francisco District, nr. La Perdiz, N of San Francisco, Río Beteguí; 8.36047°N, 80.99481°W, 144 m a.s.l.; 28 Jan 2023; leg V. Rodriguez; UV light trap"; MUPADI.

Diagnosis. *Neotrichia betegui* sp. nov. appears to be a member of the *Neotrichia caxima* group of Keth et al. (2015), based on the reduced inferior appendages with some similarity to *N. garra* Keth from Belize, which also has some sclerotisation of the genitalia, but not to the extent seen in the new species. *Neotrichia betegui* sp. nov. is also distinguished by the mesally fused inferior appendages.

Description. Male. Total length 1.7 mm (n = 1), 18 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 5). Abdominal segment VIII annular. Segment IX narrow, rounded posteriorly, anteriorly truncate; ventrally rounded posteriorly; dorsally square. Segment X triangular, tapering distally with sclerotised dorsal margin; in dorsal view square, apical margin slightly incised, posterolateral margins notched. Subgenital plate in lateral view sclerotised, narrow basally, widening distally to truncate apex, which is divided into a pair of rounded knobs; in ventral view, narrow, apically divided into pair of lobes, each bearing stout setae. Bracteole in lateral view narrow basally, over length, widening slightly distally to rounded apex; in dorsal and ventral views, narrow over length and curving, extending posteriorly as narrow band. Inferior appendage sclerotised, short and subrectangular, rugose apically; in ventral view, complex,

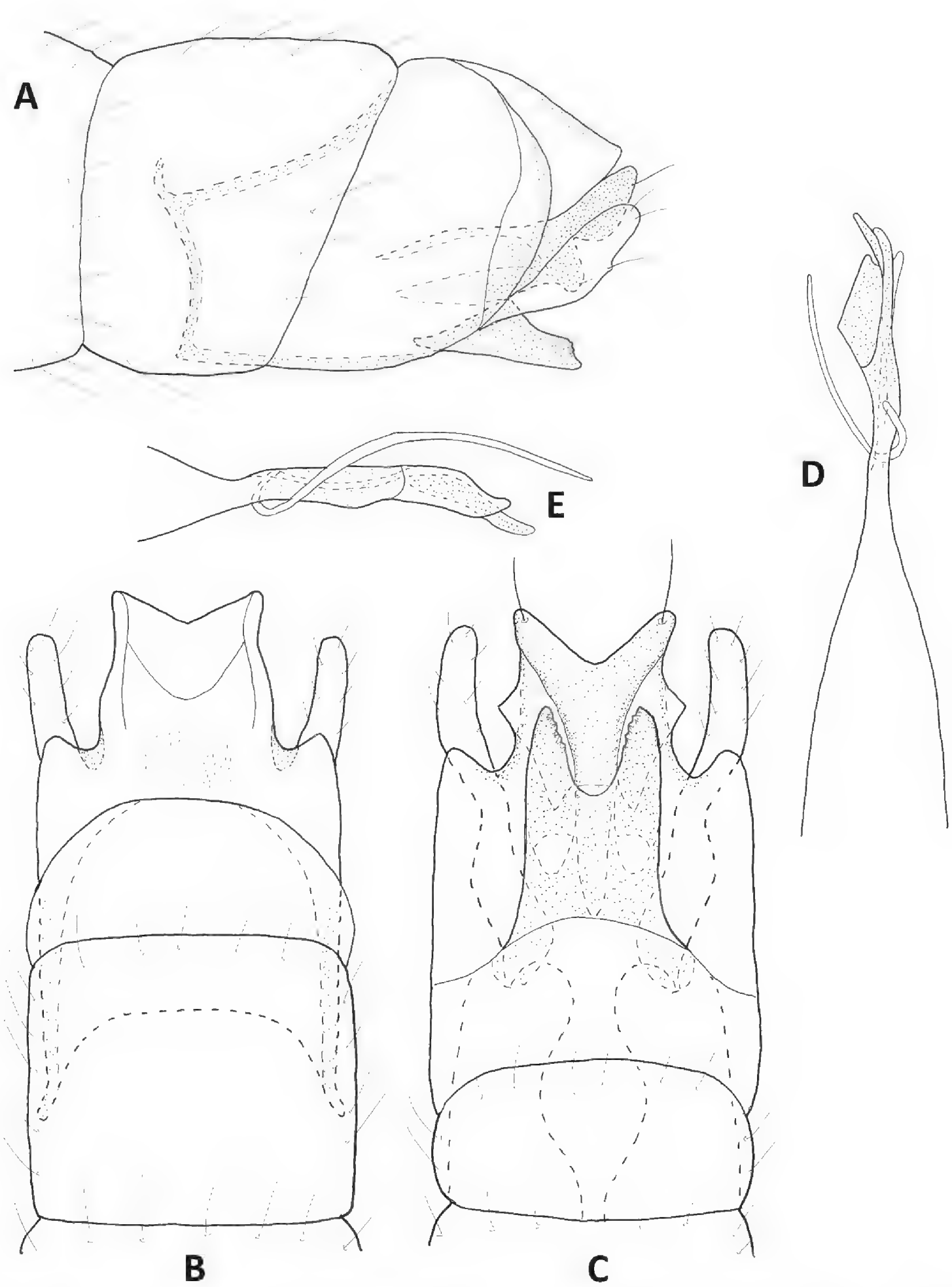

Figure 5. *Neotrichia betegui* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal **E** phallus apex lateral.

fused sub-basally, anterior portion tapering to rounded apex, rugose on inner margin, basal portion square and extending anteriorly with mesal, sinuate process. Phallus in dorsal view tubular, constricted at mid-length and bearing thin paramere encircling shaft, apex heavily sclerotised, divided into pair of elongate rods of uneven length.

Female and immature stages. Unknown.

Etymology. Named for the Río Beteguí from which the type specimen was collected. The derivation of "betegui" is unclear. The prefix "be" means exists and the Aztec word for lizard translates into Spanish as "tegui". However, we have no confirmation that this was the genesis of the specific epithet. The name is a noun in the genitive case.

***Neotrichia rancheria* sp. nov.**

https://zoobank.org/91C1B17D-4D15-4C9C-BF26-00C64C859E1A

Fig. 6

Type locality. Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.

Type specimen. ***Holotype*** • ♂, in alcohol. Original label: "Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.; 6–22 Mar 2023; leg V. Rodriguez; Malaise trap"; MUPADI. ***Paratypes*** • 9 ♂♂, in alcohol; same as holotype; MUPADI • 1 ♂; ibid., Isla Rancheria; 7.6396°N, 81.70475°W; 24 m a.s.l.; 6–21 Mar 2023; MUPADI (7 ♂♂), CMNH (2 ♂♂).

Diagnosis. The *Neotrichia canixa* group consists of a cluster of Neotropical species with an elongate dorsal process from segment IX, including *N. filifera* Flint and *N. napoensis* Harris & Davenport, but the new species is closest to *N. starki* Harris & Armitage from Bocas del Toro Province in Panama. *Neotrichia rancheria* sp. nov. is separated from *N. starki* by the shorter rods from segment XI, the setose subgenital plate and the closely appressed inferior appendages.

Description. Male. Total length 1.2–1.4 mm (n = 10), 18 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 6). Abdominal segment VIII annular. Segment IX tapering anteriorly, posteriorly incised mesally, round dorsally giving rise to elongate sclerotised rod; in ventral view, incised anteriorly and posteriorly; in dorsal view, narrowing posteriorly with pair of elongate, sclerotised rods. Tergum X tapering to truncate apex; in lateral view, visible as a basal lobe beneath rods of segment IX. Subgenital plate in lateral view wide basally, tapering distally to acute apex with stout seta, setose on dorsal margin; in ventral view, rectangular, divided apically into pair of lobes bearing stout setae and setose on outer margins. Bracteole in lateral view thin over length; in dorsal and ventral views, thin, tapering distally. Inferior appendage in lateral view ovate, slightly widening distally, setose patch on dorsal surface near mid-line; in ventral view, rectangular, apically narrowing mesally and triangular, closely appressed along mid-line. Phallus in dorsal view tubular, widening basally and apically, constricted at mid-length and bearing thin paramere encircling ejaculatory duct, sclerotised.

Female and immature stages. Unknown.

Etymology. Named for the Pacific island, Isla Ranchera, off the southern coast of Panama where the type specimens were collected. This island is part of Coiba National Park, which is a UNESCO World Heritage Site and Marine Park. Isla Rancheria, also known as Isla Coibita, is located off the NE coast of Coiba Island. The name is a noun in the genitive case.

***Neotrichia sona* sp. nov.**

https://zoobank.org/45BD322F-6B3A-420A-AE70-8434A36B0A56

Fig. 7

Type locality. Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.

Type specimen. ***Holotype*** • ♂, in alcohol. Original label: Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr.

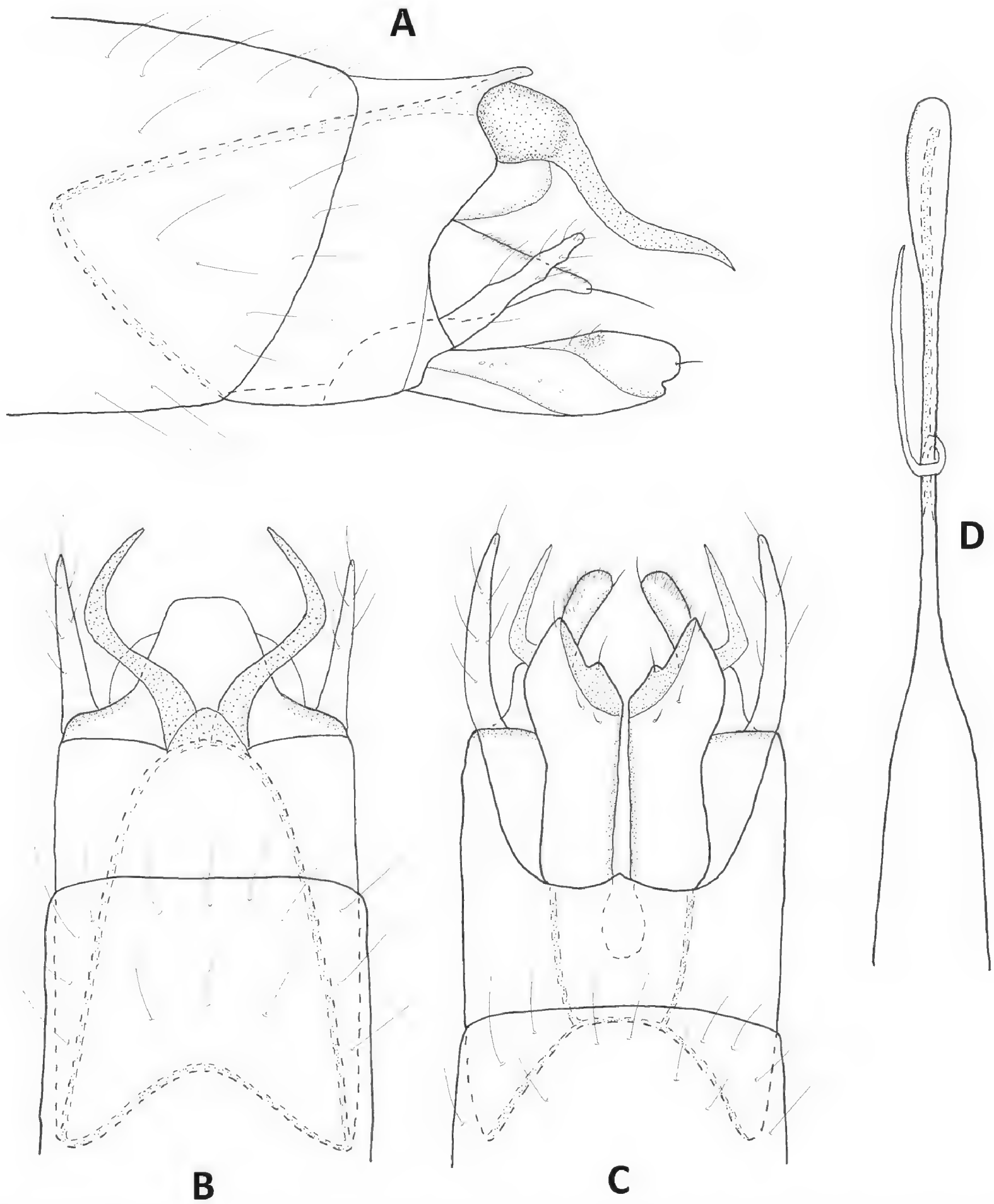

Figure 6. *Neotrichia rancheria* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal.

Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.; 20 Jan–5 Feb 2023; leg V. Rodriguez; Malaise trap"; MUPADI. ***Paratypes*** • 3 ♂♂, in alcohol; same as holotype, except: UMSP (1 ♂), CMNH (1 ♂) and MUPADI (1 ♂) • 1 ♂; ibid., same as holotype, except 21 Jan 2023; UV light trap; MUPADI.

Other material examined. 4 ♂♂, in alcohol; ibid., Cuenca 116, Las Palmas District, Quebrada del Rosario; 7.85826°N, 81.55764°W; 26 m a.s.l.; 3 Feb 2023; leg V. Rodriguez; Malaise trap; MUPADI • 1 ♂; ibid., 20 Jan–21 Feb 2023; Malaise trap; MUPADI • 3 ♂♂; ibid., 20 Jan 2023; UV light trap; MUPADI • 1 ♂; ibid., Río Indio; 7.8710°N, 81.49459°W; 703 m a.s.l.; 3 Feb 2023; MUPADI • 4 ♂♂; ibid., Quebrada La Mina; 7.87443°N, 81.51004°W; 63 m a.s.l.; MUPADI • 3 ♂♂; ibid., Soná District, Quebrada Monita; 7.81480°N, 81.55724°W; 26 m a.s.l.; 20 Jan–4 Feb 2023; Malaise trap; MUPADI • 15 ♂♂; ibid., 21 Jan 2023, UV light trap; MUPADI • 17 ♂♂; ibid., 11 Apr 2023; UMSP (8 ♂♂), CMNH (9 ♂♂).

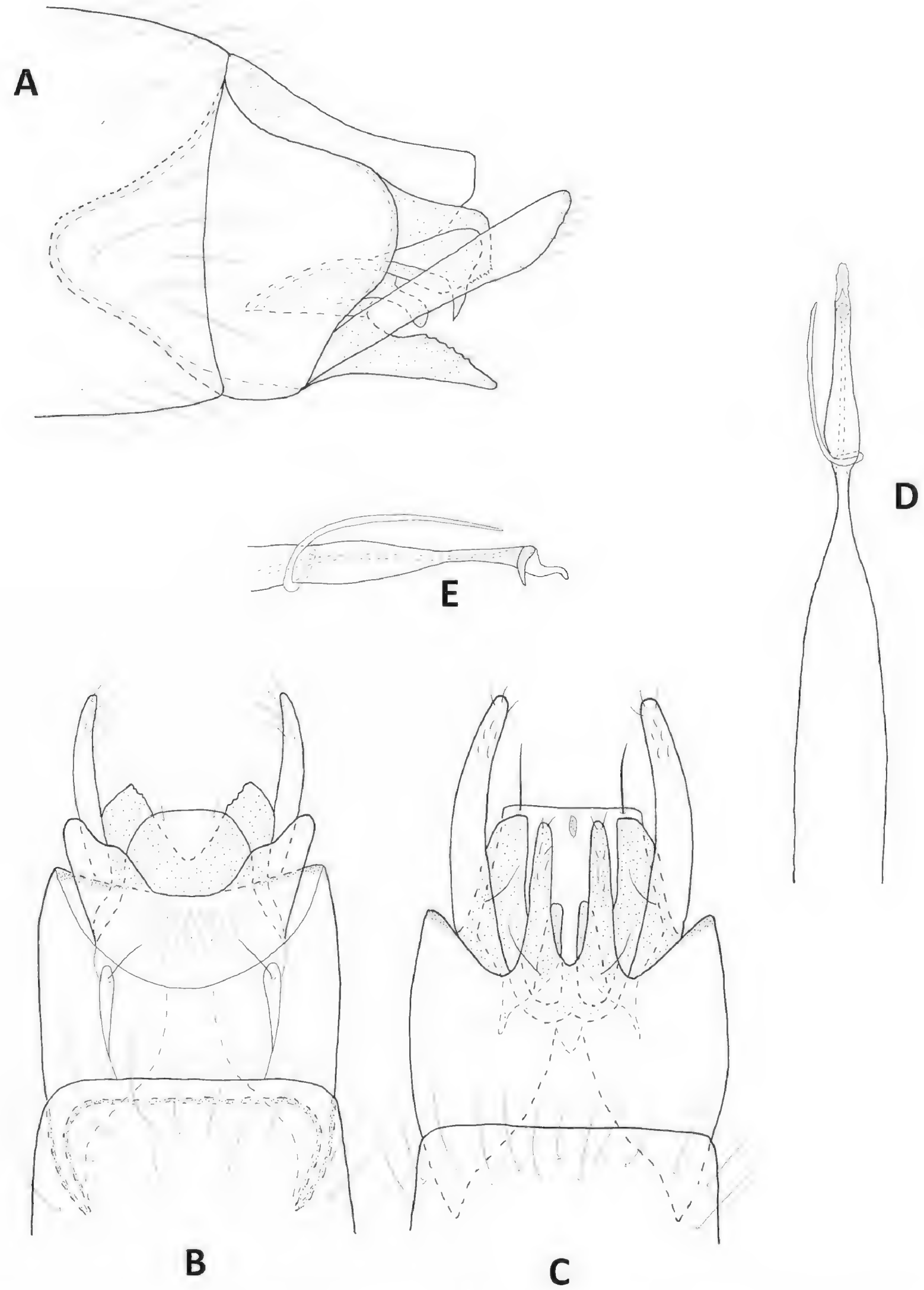

Figure 7. *Neotrichia sona* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal **E** phallus apex, lateral.

Diagnosis. *Neotrichia sona* sp. nov. appears to be a member of the *Neotrichia vibrans* group of Keth et al. (2015), based on the apicolateral extension of segment IX and the tapered margins of tergum X. The new species appears to be similar to *N. helios* Flint from Jamaica which also has a tapering inferior appendage and simple phallus. The new species is distinguished by the knob-like dorsal process of the inferior appendage, the serrate apical margin of the lateral process from segment IX and the small, rounded pre-apical sclerite of the phallus.

Description. Male. Total length 1.6–1.8 mm (n = 30), 18 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 7). Abdominal segment VIII annular. Segment IX narrow, rounded posteromesally and incomplete dorsally, posteriorly with truncate dorsolateral extension which is sclerotised and serrate distally, anteriorly rounded mesally; ventrally rectangular; dorsally with deep posteromesal incision, inner margins serrate, posterolateral margins rounded. Segment X narrowing posteriorly to truncate shelf; in dorsal view, reduced to a pair of rounded lateral knobs which taper mesally. Subgenital plate in lateral view, narrow basally, widening distally to acute, posteriorly projected spine; in ventral view, square, posterior margin truncate bearing pair of stout setae. Bracteole in lateral view narrow over length, widening slightly apically; in ventral and dorsal views, narrow over length and curving. Inferior appendage sclerotised, tapering distally to rounded apex, rugose on dorsal margin, anteriorly with sclerotised dorsal knob; in ventral view, wide basally, tapering distally to rounded apex, basally with short rectangular process. Phallus in dorsal view, tubular, constricted at mid-length and bearing thin paramere encircling shaft, apex narrowing distally, small rounded sclerite pre-apically; in lateral view, pre-apical sclerite projects downwards and narrows to a point.

Female and immature stages. Unknown.

Etymology. Named for the peninsula, district, corregimiento and town along the Pacific coast of Panama. One suggested derivation of the word "soná" is from a local indigenous language, in which *sonáre* means “murmur of the waters”. This refers to the numerous riverbeds that surround the region. The name is a noun in the genitive case.

Family Hydroptilidae Stephens, 1836
Subfamily Ochrotrichiinae Marshall, 1979

Genus *Metrichia* Ross, 1938

Note. The genus *Metrichia* includes over 141 species of caddisflies (Thomson 2023) distributed almost entirely in the Neotropics. Currently, there are 49 species known from Panama (Armitage et al. 2024). Herein, we describe and illustrate one additional species for the country.

Metrichia riosi sp. nov.

https://zoobank.org/B8C81D71-2B06-4766-B95C-CACADB94C1FC

Fig. 8

Type locality. Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.

Type specimen. ***Holotype*** • ♂, in alcohol. Original label: Panama: Veraguas Province, Soná District, Canales de Afuera Island off the Soná Peninsula nr. Pixvae; 7.69494°N, 81.62649°W; 29 m a.s.l.; 6–22 Mar 2023; leg V. Rodriguez; Malaise trap”; MUPADI. ***Paratypes*** • 5 ♂♂, in alcohol; same as holotype; MUPADI.

Diagnosis. *Metrichia riosi* sp. nov. is similar to *M. trebeki* Harris & Armitage, *M. rawlinsi* Flint & Sykora and *M. triquetra* Bueno-Soria & Holzenthal, based on

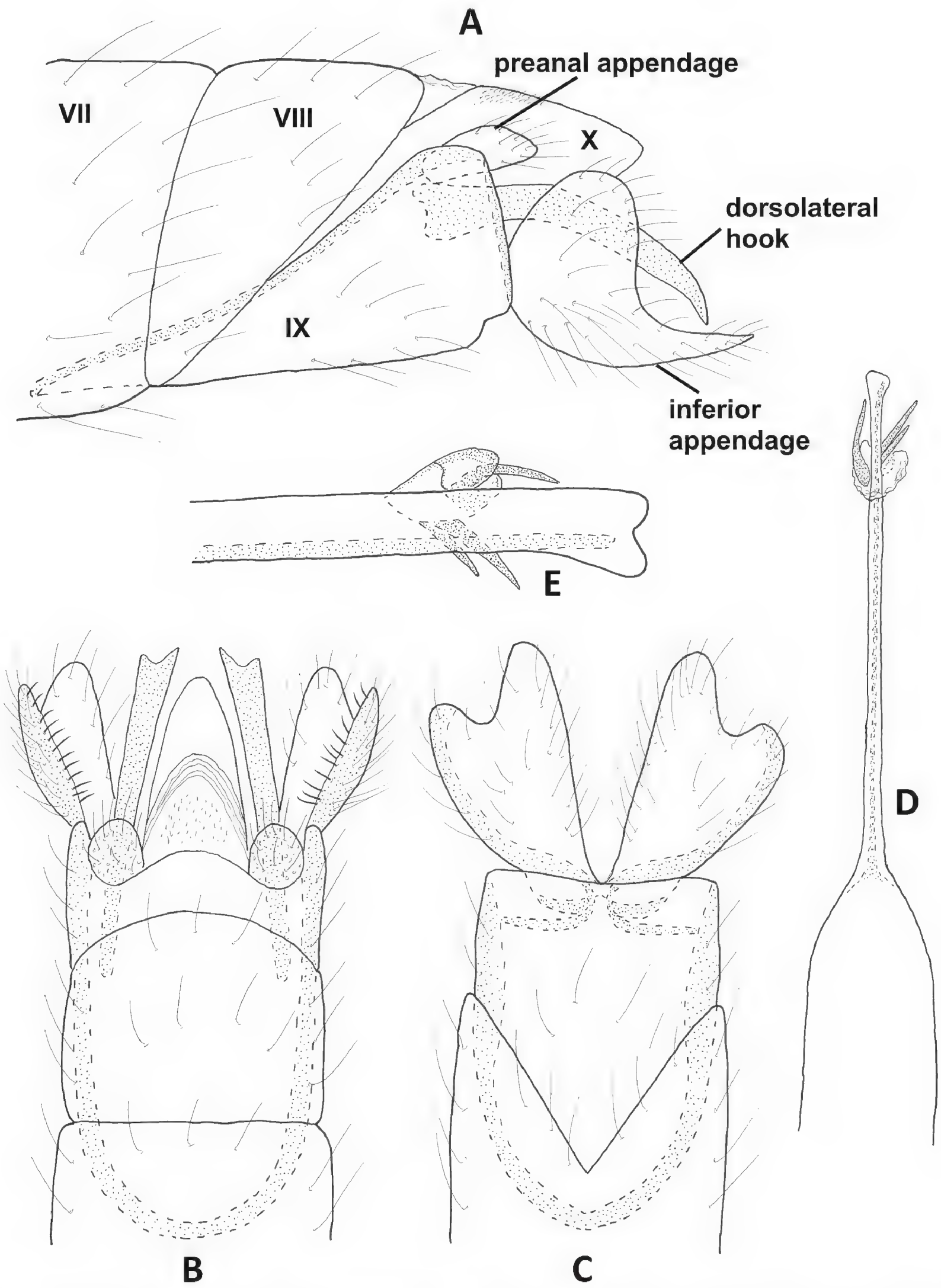

Figure 8. *Metrichia ríosi* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, dorsal **E** phallus apex, lateral.

the shape of inferior appendage in lateral view, but it differs from these species in the structure of the phallus, which has three subapical spines.

Description. Male. Total length 2.1–2.3 mm (n = 6), 18 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 8). Abdominal segment VII annular, without ventromesal process. Segment VIII in lateral view, triangular, tapering ventrad; in dorsal view, annular; in ventral view, deeply incised mesally. Segment IX in lateral view, truncate posteriorly, narrowing anteriorly and extending into

segment VII, incomplete dorsally; in dorsal view, reduced to a narrow band, lateral margins sclerotised, rounded anteriorly; in ventral view, truncate posteriorly, lateral margins sclerotised, rounded anteriorly. Segment X in lateral view, shelf-like, rounded distally; in dorsal view, thinly rectangular, rounded apically. Pre-anal appendage (cercus) narrowly rounded in lateral view; in dorsal view, circular; dorsolateral hook in lateral view elongate, thin and tapering distally; in dorsal view, widening distally with apex incised, extending beyond inferior appendages. Inferior appendage in lateral view circular basally, narrowing ventrally and tapering to thin acute apex; in dorsal and ventral views, divided apically into pair of lobes, sclerotised in outer margin. Phallus elongate, wide basally then narrow over length, three elongate spines subapically, ejaculatory duct sclerotised over length.

Female and immature stages. Unknown.

Etymology. Named for Tomás A. Ríos González, Panamanian biologist at the Museo de Peces de Agua Dulce e Invertebrados of the Universidad Autónoma de Chiriquí in recognition of his intensive and extensive involvement with our studies of aquatic insects in Panama. The name is a noun in the genitive case.

Genus *Ochrotrichia* Mosely, 1934

Note. The genus *Ochrotrichia* includes over 226 species of caddisflies (Thompson 2023) distributed primarily in North, Central and South America. Currently, there are 42 species known from Panama (Armitage et al. 2024). Herein, we describe and illustrate two additional species for the country.

Ochrotrichia mariettae sp. nov.

https://zoobank.org/3B769554-8699-4E2B-94F0-B81DBE27170A

Fig. 9

Type locality. Panama: Chiriquí Province, Cuenca 102, Renacimiento District, Reserva Privada Landis, Location 1, quebrada sin nombre; 8.643769°N, 82.829479°W; 755 m a.s.l.

Type specimen. Holotype • ♂, in alcohol. Original label: Panama: Chiriquí Province, Cuenca 102, Renacimiento District, Reserva Privada Landis, Location 1, quebrada sin nombre; 8.643769°N, 82.829479°W; 755 m a.s.l.; 30 Dec 2022; leg M. Landis; Malaise trap"; MUPADI. **Paratype** • ♂, ibid., same as holotype, except Location 2; 8.64501°N, 82.82204°W; 575 m a.s.l.; 29 Feb–16 Mar 2020; MUPADI.

Diagnosis. Based on the sigmoid shape of the inferior appendage which bears thick spines apically, this species is placed in the *O. arranca* group of Flint (1972), with some similarity to *O. pulgara* Harris & Armitage and *O. tagala* Flint, both of which have the apex of the inferior appendage modified into a thumb-like process. It differs from these species and others in the group, based on the tenth tergum which is divided distally into two short processes, one of which bears a terminal spine; and by the short inferior appendage, which is similar in appearance to those of *O. amorfa* Bueno-Soria and Holzenthal.

Description. Male. Total length 2.0 mm (n = 2), 26 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 9). Abdominal segment VII and VIII annular, the former with a small posteroventral process. Segment IX in lateral

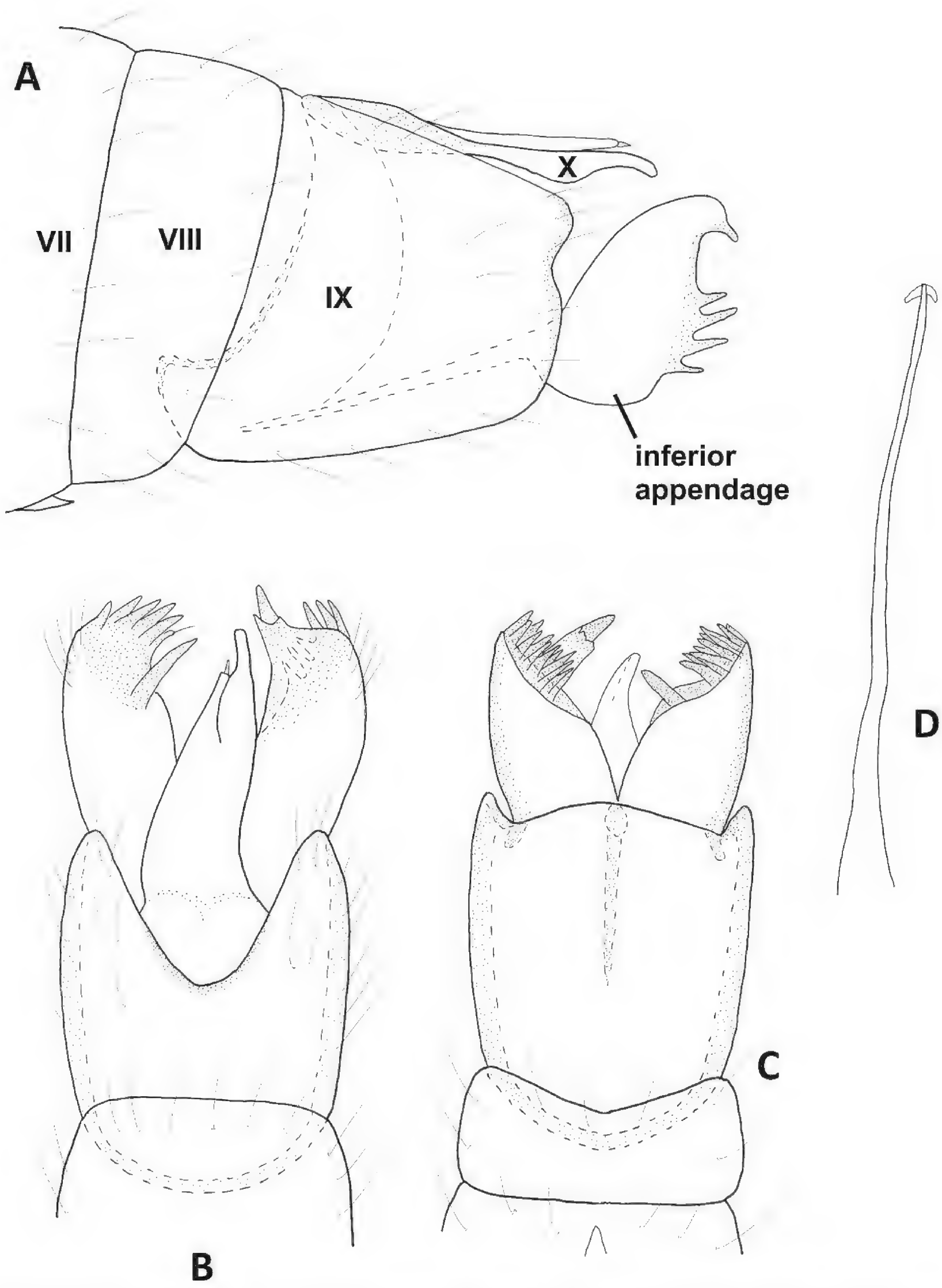

Figure 9. *Ochrotrichia mariettae* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, ventral.

view posteriorly sinuate, tapering dorsally and ventrally, broadly incised anteriorly forming ventral knob; in ventral view, rounded posteriorly and anteriorly, notched posterolaterally; in dorsal view, with broad mesal incision. Tergum X slightly divided distally, right process narrow, bearing stout apical spike, left process wide basally, tapering to rounded apex; in lateral view, upper spinose process, narrow over length, lower process sinuate ventrally, lobate apically. Inferior appendage in lateral view sigmoid-shaped, posterodorsal finger-like

process, cluster of dark rounded spikes posteroventrally; in dorsal and ventral views, wide basally, gradually tapering distally to acute, numerous thick darkened spikes on posterior margins. Phallus in ventral view, thin and elongate, apically with pair of small lateral lobes.

Female and immature stages. Unknown.

Etymology. Named in honour of Señora Marietta Landis, who provided permission and access to her private reserve in western Panama near the Costa Rican border and who made all of the collections, including those of this and several other new species. The name is a noun in the genitive case.

***Ochrotrichia martinez* sp. nov.**

https://zoobank.org/0DD6358D-EFCE-4E11-A4D5-D83D9D3875B4

Fig. 10

Type locality. Panama: Comarca Ngäbe-Buglé, Cuenca 093, Kankintú District, Bosque Protector Palo Seco, Quebrada Martínez, detrás de las caseta de MiAmbiente; 8.79484°N, 82.19047°W; 480 m a.s.l.

Type specimen. Holotype • ♂, in alcohol. Original label: "Panama: Comarca Ngäbe-Buglé, Cuenca 093, Kankintú District, Bosque Protector Palo Seco, Quebrada Martínez, detrás de las caseta de MiAmbiente; 8.79484°N, 82.19047°W; 480 m a.s.l.; 12–29 Nov 2019, leg Y. Aquirre and T. Ríos; Malaise trap"; MUPADI. **Paratypes** • 3 ♂♂, in alcohol, ibid., 13–27 Apr 2019; MUPADI • 4 ♂♂, in alcohol, ibid., 24 Apr–8 May 2019; MUPADI • 12 ♂♂, in alcohol, ibid., 24 May–9 Jun 2019; MUPADI • 4 ♂♂, in alcohol, ibid., 8–22.vi.2019; MUPADI • 2 ♂♂, in alcohol, ibid.,16–30 Aug 2019; MUPADI • 1 ♂, in alcohol, ibid.,13–27 Sep 2019; CMNH • 2 ♂♂, in alcohol, ibid., 11–30 Oct 2019; CMNH.

Other material examined. 21 ♂♂, in alcohol, Cocle Province, Cuenca 105, La Pintada District, Omar Torrijos National Park, Quebrada Corazones, PSPSCBPNGDOTH-C103-2017-001, 8.67760°N, 80.60007°W, 728 m a.s.l.; 24 Mar 2017; leg A. Cornejo, E. Pérez, T. Ríos, E. Alvarez, and C. Nieto; UV light trap • 1 ♂, in alcohol, ibid., afluente Quebrada Corazones, PSPSCB-PNGDOTH-C103-2017-002; 8.67801°N, 80.60006°W, 792 m a.s.l.; 24 Mar 2017; leg A. Cornejo, T. Ríos, E. Álvarez, and E. Pérez; UV light trap • 4 ♂♂, in alcohol, Chiriqui Province, Cuenca 108, Boquete District, Quebrada Jaramillo Abajo; 8.74583°N, 82.41808°W, 1059 m a.s.l.; 6 Mar 2019; UV light trap; leg K. Castillo • 5 ♂♂, in alcohol, Comarca Ngäbe-Buglé, Cuenca 093, Kankintú District, Bosque Protector Palo Seco, Quebrada Martínez, Willie Mazu; 8.79361°N, 82.19391°W, 538 m a.s.l.; 30 Aug 2019; leg Y. Aquirre and T. Ríos; UV light trap; 6 ♂♂, in alcohol, ibid.,16–30 Aug 2019; Malaise trap • 2 ♂♂, in alcohol, ibid.,13–27 Sep 2019 • 5 ♂♂, in alcohol, ibid., 27 Sep–11 Oct 2019 • 4 ♂♂, in alcohol, ibid., 8–12 Oct 2019 • 6 ♂♂, in alcohol, ibid.,11–30 Oct 2019 • 1 ♂, in alcohol, ibid.,12–26 Nov 2019 • 3 ♂♂, in alcohol, ibid.,12–29 Dec 2019 • 21 ♂♂, in alcohol, Veraguas Province, Cuenca 097, Santa Fe District, Santa Fe National Park, Río Calovebora, PSPSCD-PNSF-CO97-2017-005; 8.54318°N, 81.16398°W; 536 m a.s.l., 19–23 Apr 2017, leg T. Ríos, E. Álvarez and C. Nieto; Malaise trap • 28 ♂♂, in alcohol, ibid., Cuenca 132, Quebrada Primo Brazo Mulabá, PSPSCD-PNSF-C132-2017-008; 8.51706°N, 81.12181°W; 770 m a.s.l.; 19 Apr 2017.

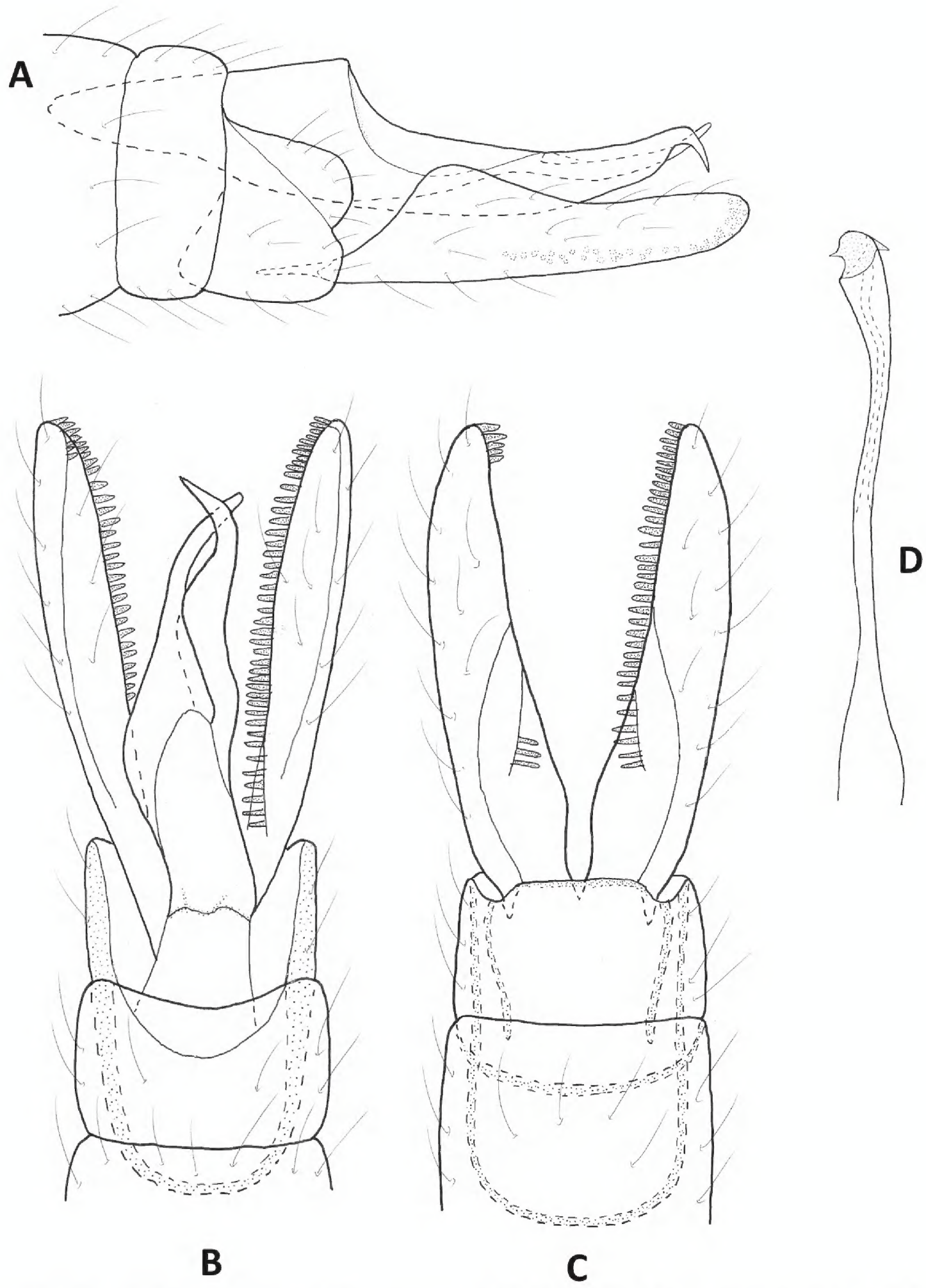

Figure 10. *Ochrotrichia martinez* sp. nov., male holotype, genitalia **A** left lateral **B** dorsal **C** ventral **D** phallus, ventral.

Diagnosis. Based on the elongate inferior appendages, this species is placed in the *Ochrotrichia tenango* group of Flint (1972), with some similarity to *O. assita* Bueno-Soria and Holzenthal and *O. longispina* Bueno-Soria & Holzenthal, both of which occur in Panama. The new species is separated by the length of the inferior appendage which is approximately 6 times as long as wide, while in *O. longispina*, the ratio of length to width is 9×. In *O. assista*, the ratio of length to width in the inferior appendages is approximately 3× and the shape is rectangular, while in the new species and *O. longispina*, the width is narrow. There is also some similarity to *O. froehlichi* Desiderio, Moreno and Hamada from Brazil, but in this species, the length of the inferior appendage is not as long as that of the new species and the apex of tergum X is shallowly rather than deeply divided.

Description. Male. Total length 2.5–3.5 mm (n = 25), 38 antennal segments, wings and body brown in alcohol. ***Genitalia*** (Fig. 10). Abdominal segment VII and VIII annular, the former lacking a posteroventral process. Segment IX in lateral view posteriorly sinuate, tapering anterodorsally; narrowing anteriorly and deeply divided mesally; in ventral view, truncate; in dorsal view, with wide mesal incision. Tergum X divided at mid-length, right process wide basally, narrowing distally to acute apex, left process sinuate, widest at mid-length and acute apically; in lateral view, upper process, wide at mid-length, narrowing apically to downturned hook, lower process thin over length, gently curving upwards. Inferior appendage in lateral view thin and elongate, about 6 times as long as wide, widest sub-basally, tapering distally, apex rounded, numerous peg-like setae on inner posterior and ventral margin; in dorsal and ventral views, wide basally, gradually tapering distally to rounded apex, peg-like setae continuous on mesal margins. Phallus in dorsal view thin and elongate, widening apically to rounded knob, with sharp points subapically.

Female and immature stages. Unknown.

Etymology. Named for the stream, Quebrada Martínez, in which the types were collected. Located in the Bosque Protector Palo Seco Protected Area, administered by the Ministerio de Ambiente, on the Panama's Caribbean slope, this is a first order stream in the Río Guabo watershed of the Ngäbe Buglé Comarca (Kankintú District). The word Martínez is a masculine name peculiar to Hispanic-American communities and means "son of Martin". "Martin" is the Spanish form of the name "Martinus", associated with the name Mars, which from the Latin implies "male". The name is a noun in the genitive case.

Discussion

Initially, our collections on the Soná Peninsula were made to compare and contrast with caddisfly assemblages on the islands of Coiba National Park. So far, for all Trichoptera species (unpublished data), there appears to be some overlap between these two areas, but also more than a few unique species on the islands. All of the five new species above from these two areas (*Neotrichia afuera* sp. nov., *N. aguirrei* sp. nov., *N. rancheria* sp. nov., *N. sona* sp. nov. and *Metrichia riosi* sp. nov.) were described from Isla Canales de Afuera, an island ~ 6 km distant from the mainland. One of these five species, *Neotrichia rancheria* was also found on Isla Rancheria (~ 16 km distant from the mainland and very close to Coiba Island). In addition, two of the species, *N. aguirrei* sp. nov. and *N. sona* sp. nov., described from Isla Canales de Afuera, were found at different locations on the Soná Peninsula. Subject to additional collecting, we can say that the data suggest some speciation has occurred in isolation on Isla Canales de Afuera. We would also note that other more common microcaddisfly species found in different locations throughout western Panama are also present on that island (e.g. *Neotrichia armata* Botosaneanu, *N. carlsoni* Harris & Armitage and *N. xicana* (Mosely)).

The addition of five more species of the genus *Neotrichia* continues a remarkable story which seemingly has no end. Starting with three recorded species when we started our research in Panama in 2014, we have added 42 new species and new country records. Now that total is 50, including the five new species described herein.

Similarly, the number of caddisfly taxa in Panama shows no signs of slowing down. The 257 species recorded when we began our work increased to 535,

more than double the number, by 2024. With the publication of this manuscript, Panama now boasts 544 caddisfly species.

Two of the species (*N. aguirrei* sp. nov. and *Metrichia riosi* sp.nov.) were named for aquatic biologists at MUPADI in recognition of their selfless work to make the progress and successes, which AIRG has experienced, a reality. In several previous publications (Blahnik et al. 2023; Harris et al. 2023; Harris et al. 2024), they became the first Panamanians to describe new species of caddisflies from Panama. Up to that point, all new species and new country records were generated by non-Panamanians primarily from North America. Given that most of these latter contributors are becoming long in the tooth, there is an even greater need for Panama and other Central American countries to train and support their own taxonomic experts.

Finally, the results in this paper are also a significant contribution to our knowledge of caddisfly distributions in Panama. Before this, no adult taxa were recorded in the refereed literature from Coiba National Park and only a few species, based on AIRG work, from the Soná Peninsula. Considering that most areas in Panama have never been collected, we anticipate that much more remains to be learned about the fauna and distribution of caddisflies in Panama.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

Conceptualisation: BJA, VR. Data curation: BJA, SCH. Formal analysis: BJA. SCH, VR. Writing and editing (BJA, SCH). Funding acquisition: BJA.

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Data availability

All of the data that support the findings of this study are available in the main text.

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